Interagency Ecological Studies Program for the Sacramento-San Joaquin Estuary

NEWSLETTER

Winter 1992

Readers are encouraged to submit brief articles or ideas for articles. Correspondence, including requests for changes in the mailing list, should be addressed to Randy Brown, California Department of Water Resources, 3251 S Street, Sacramento, CA 95816-7017.

Stanford University and San Francisco Bay

Stephen G. Monismith and Jeffrey R. Koseff

A moderate research effort has evolved in Stanford's Environmental Fluid Mechanics Laboratory, largely involving NRF researchers Jim Cloern, Fred Nichols, Jan Thompson, Brian Cole, and Ralph Cheng. Organized within Stanford's Dept. of Civil Engineering, the EFML has 3 full-time faculty (Jeffrey Koseff, Stephen Monismith, and Robert Street), 18 PhD students, and several masters students working on experimental and numerical studies applying fluid mechanics principles to environmental flows.

Current San Francisco Bay research consists of two interrelated projects. One is an NSF-funded study of hydrodynamic effects on benthic grazing by bivalves, *eg* the Asian clam *Potamocorbula amurensis*. The other project is funded by the EPA San Francisco Estuary Project and involves effects of freshwater flows on hydrodynamics and phytoplankton dynamics. This article focuses on the second project.

The flow project involves 5 principal investigators (Koseff, Monismith, and David Freyberg from Stanford and Tom Powell and Alan Jassby from UC, Davis) 2 PhD students (Jon Burau and Jackie Holen), and 2 masters students (Derek Fong and Ann Fridland).

The Stanford component of the flows project involves several elements: numerical modeling of tidal circulation, phytoplankton dynamics, and stratification dynamics; examination of field hydrodynamic data; and examination of Delta hydrology.

Horizontal Mixing

This effort by Jon Burau, Monismith, Koseff, and Tom Powell is aimed at using a currently operational 2D, depth-averaged tidal circulation numerical model (the "TRIM" code developed by Ralph Cheng and Vicenzo Casulli) to examine the potential effects of freshwater inflows on purely physical transports for a series of hypothetical outflow scenarios. Among uses we plan for model results is estimating the magnitude of advective contributions to the total organic carbon budget of the estuary that Powell and Alan Jassby are studying. As Jassby discussed in his contribution to the Aquatic Resources *Status and Trend Report* (a review prepared for the EPA Estuary Project by Bruce Herbold, Alan Jassby, and Peter Moyle), these are among the least understood parts of the carbon budget.

Practical limitations rule out use of a 3D model of the entire estuary; the 2D model is an idealization and does not capture all the relevant physics. It relies on vertical averaging of the governing equations. Accurate 2D models with sufficient spatial resolution to accurately represent topographic effects often do a good job at representing tidal time-scale flows and a passable job at representing intratidal time-scale scalar transport.

Besides working on practical aspects of using TRIM, Burau (in collaboration with Cheng) carried out a highly-resolved calculation of tidal flow in Suisun Bay (grid points 50m apart). Results made it apparent that horizontal (longitudinal) mixing tended to happen in a patchy, filamentous fashion, with narrow filaments of fresh water being stretched several kilometers between filaments of salty water, and *vice versa*. These filaments were created by transverse shear between channels and shoals and then appeared to be mixed by lateral instabilities that developed in the shear layers formed at the edges of the channels and in the wakes of islands (submerged or surface-piercing). All in all, the flowfield was a much more dynamic one than what one would see in a less well resolved calculation or what one might discern from any of the existing field surveys except recent work with the downward-looking Doppler sonar.

These preliminary results are of a striking nature and may have many important implications, both for the nature of longitudinal

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transport in Suisun Bay and for resolution requirements for 3D circulation modeling. However, the general picture revealed by the model is significantly different from the traditional picture of Suisun Bay, especially the conceptual model of the entrapment zone. Burau has also been working with Cheng running test cases to carefully examine the accuracy of the TRIM code when run with high resolution in a flow domain with bathymetry as complex as that of Suisun Bay.

Burau has also been working on establishing boundary conditions for the whole bay runs that will constitute the bulk of this part of the flows project. The basic idea is that boundary conditions applied to the model must be placed at some distance from any place in the bay where we want to calculate the flow. Thus, at the ocean side, the model domain has been extended outside the Golden Gate so that Bay/Ocean exchanges can be modeled. At the Delta side, with assistance of USGS staff as part of the Interagency Hydrodynamics Program, the model is being extended into the Delta upstream of Chipps Island. Due to the limited time of our project, and to ensure that Jon Burau finish his PhD, we have decided for now not to extend the model all the way to the outer edges of the Delta.

Vertical Mixing

To aid with interpretation of data pertaining to stratification/destratification events in San Francisco Bay, Stephen Monismith and Derek Fong have developed a simple model of vertical mixing in a stratified tidal flow. The model is similar to those commonly used to study mixed-layer dynamics in lakes and the ocean.

The model flow is driven by a specified surface pressure gradient due to barotropic tidal motions. In the bottom mixed layer, the balance of forces is between the surface pressure gradient, the shear stress gradient arising from the bottom stress, and unsteady inertia. Because stratification significantly inhibits momentum and energy transfer, the shear stress is assumed to vanish above the pycnocline that caps the bottom mixed layer. As a consequence, the flow above the mixed layer is not affected by bottom stresses, leading to development of substantial shear across the mixed-layer pycnocline.

Relying on a greatly simplified description of the physics of the flow, the model incorporates two means for accomplishing vertical mixing: shear instability, and bottom mixed-layer deepening by turbulence produced at the estuary bottom and in the shear layer at the top of the mixed layer.

The shear instability model, originally developed to model oceanic mixed-layer deepening, mixes properties of adjacent grid points according to a local stability criterion. The mixed-layer deepening model is based on an integral energy balance equating changes in potential energy to the net production of turbulent kinetic energy.

Model results obtained to date for a single tidal component and average conditions shows that large tidal shears develop due to the differential effect of bottom friction. More important, the model reveals that it is the combined action of shear instability and tidal "stirring" that accomplishes vertical mixing. Shear instability weakens the stability of the mixed layer, allowing stirring to efficiently entrain lighter fluid into the mixed layer. As it is traditionally described (without shear), tidal stirring appears ineffectual and not likely to lead to significant changes in bottom-mixed layer depth or buoyancy.

The main specific test case we have run attempts to simulate a stratification/destratification event observed in South San Francisco Bay in March and April 1989. The model has been run with realistic tides (tidal constants taken from USGS data) and calculates that vertical mixing would have required about 4 days to complete. The field data, taken 4 days apart, show stratification on the first day and no stratification on the fifth day. This suggests the model is in the ballpark, at least as far as the gross energetics of mixing is concerned.

We have also completed several model runs that show the rate of vertical mixing depends, in a relatively straightforward way, on the tidal forcing and the stratification strength. These model results can then be used to estimate for different parts of the bay how long it would take, without additional stratifying flows of fresher water, for vertical density stratification to disappear. Bearing in mind the simplifying assumptions made in developing the model (in particular, that of horizontal homogeneity), the model predicts that the time for complete vertical mixing is inversely proportional to the average (rms) speed of the tidal current raised to the fifth power. For example, this sensitivity to variations in tidal current means a 20 percent increase in tidal current amplitude during a spring tide relative to that of a neap tide would reduce the mixing time of a given stratification by 60 percent relative to that characteristic of a neap tide. This implies that most of the vertical mixing of stratification (and, thus, other constituents) would occur during spring tides.

In its present form, the model probably best describes stratification dynamics in South Bay, where episodic freshwater flows create density stratification that is subsequently mixed out. In contrast, the model needs a significant change, which has been made recently — the addition of the effects of the persistent longitudinal salinity gradient — to have any chance of modeling stratification in San Pablo Bay and Suisun Bay. The reason is that even for spring tides, the predicted time for vertical mixing in Suisun Bay is generally at least several tidal cycles. Apparently, observed spring/neap cycles of stratification/destratification are not the direct result of vertical mixing but, rather, can probably be attributed to "tidal straining"; that is, to advective elimination of stratification (Larry Smith, personal communication, 1991).

To better model stratification, and especially tidal straining in Suisun Bay, we have begun to work with a more sophisticated model of the turbulence provided to us by Dr. Alan Blumberg of Hydroqual. Besides modeling unstratified and stratified flows (allowing us to carry our calculations past the point where the water column becomes unstratified due to advection), this model will also provide us with mixing coefficients that can be directly used in our phytoplankton model (described below).

Phytoplankton Dynamics

To examine mechanisms controlling phytoplankton blooms in San Francisco Bay, Jackie Holen, Koseff, Monismith, and Powell have developed a simple model of phytoplankton biomass dynamics in a hypothetical one-dimensional (vertical) version of the bay. We are especially interested in looking at connections between mixing, benthic grazing, and phytoplankton production because of the connection between freshwater flow and the efficiency of benthic control of pelagic phytoplankton. As first suggested by Jim Cloern in the early 1980s for South Bay and later by Fred Nichols for Suisun and San Pablo bays, in the absence of stratification, benthic grazing appears to be sufficient to consume all new production of phytoplankton biomass; when stratification is present, it suppresses vertical mixing, eliminating the ability of bottom-dwelling grazers (like *Potamocorbula amurensis*) to consume phytoplankton cells that reside above, in the photic zone. Thus, as the argument goes, since the presence and strength of density stratification is connected to Delta outflow, the standing stock of phytoplankton biomass in the channels would seem to be directly connected to flow.

As part of the flows study, we, in conjunction with Jim Cloern, developed a numerical model that addresses these issues in a more formal way — extending Cloern's back-of-the-envelope calculation to one that ultimately requires substantially more paper. Our model consists of a one-dimensional advection/diffusion equation that is a first-order description of how the depth distribution of the concentration of phytoplankton biomass distribution evolves in time. At present, the model accounts for production of biomass by photosynthesis, grazing by zooplankton in the water column, sinking, turbulent mixing, and consumption of biomass at the lower boundary by benthic bivalves.

Before doing any numerical analysis, we carried out dimensional analysis of the mathematical equation and associated boundary conditions. This work showed how phytoplankton distribution might depend on the net phytoplankton production rate, the sinking rate of algal cells, the characteristic turbulent diffusion rate, and the benthic grazing rate. These rates can be used to define timescales appropriate to each process. An initial parametric study was performed to determine for what range of the ratios of the production timescale to sinking timescale, turbulent diffusion timescale, and benthic grazing timescale the depth-averaged biomass increased (a bloom) and for what range the biomass decreased (a bust). In this initial study, the parameters were kept constant in space and time. In all cases, after an initial adjustment period, the biomass either increases or decreases monotonically over several weeks; thus, these cases do not recreate a bloom/bust cycle.

Next, the model parameters were varied in an attempt to represent conditions in San Francisco Bay. Phytoplankton sinking and benthic grazing rates were kept constant in the simulations, but we allowed for temporal and spatial variation in the turbulent mixing rate. Although a bloom can be simulated with a mixing rate that is chosen to be constant in depth and varies sinusoidally over a 2-week period, the addition of diurnal variation to this mixing rate greatly reduces growth. Furthermore, with more realistic values of a spatially and temporally variable mixing rate, no bloom occurs. Again the general range of biomass behavior was explored using the model; although numerical values were different, the basic behavior was the same as we had calculated for the case with constant mixing coefficients. In essence, any reasonable estimate we could make of the various physical and biological parameters put us in the regime where biomass decreased with time.

To simulate stratification in the water column, our first effort was to place a region of drastically reduced vertical mixing rate in the water column. Essentially, the turbulent mixing coefficient was set nearly equal to zero at the level of our ersatz density interface. Away from this region of reduced mixing, the mixing coefficient was smoothly increased to values appropriate to a homogeneous water column. The reduced mixing region existed at the start of the simulation period but after 6 days was quickly removed, simulating the effect of loss of stratification described in the model discussed above. To our surprise, runs made with parameter values thought appropriate to South Bay failed to show any difference between cases with and without "stratification". Only for cases with currents far weaker than appropriate were we able to produce blooms.

These results led us to consider a second stratification model, one in which the mixing coefficient remained near zero above the "density interface" but was identical to the first model below the interface. This model is valid only if we assume wind mixing at the surface is negligible. This second model did give the behavior we expected to see with the first model. With parameters set to those appropriate for South Bay, we achieved a sizeable bloom — a 15 times increase in biomass in one week.

We reached the following conclusions:

- A detailed knowledge of the effects of stratification on vertical mixing may be necessary to determine whether stratification permits blooms to form. This strongly supports our hypothesis that understanding vertical mixing processes in San Francisco Bay is important to understanding how physical variability affects phytoplankton production.
- Blooms can only be achieved if we assume the upper surface layer has negligible mixing due to wind (second stratification model). When the effects of wind are allowed (first stratification model), no blooms occurred. Wind mixing could, therefore, play an important role in phytoplankton dynamics in the bay.
- In no case could blooms form without stratification, given our best estimates of benthic grazing rates.

Although Holen has now left our group to pursue other interests, this work will be continued by graduate student Lisa Videgar, who arrived at Stanford in fall 1991. We see this work continuing in two ways:

- Couple the phytoplankton model directly to a model of the hydrodynamics that details how vertical mixing rates are connected to dynamically evolving stratification.
- Add a depth-averaged version of the vertical phytoplankton model to TRIM to examine questions associated with horizontal variability such as that seen in Suisun Bay, where primary production occurs almost entirely in the shallows.

Summary

This article is intended to give some idea about elements of our current research on San Francisco Bay — what we are doing and what we are finding out. If you have questions or comments, please contact Stephen Monismith at 415/723-4764.

South Delta Barriers

DWR and USBR are applying for a 1-year permit from USCE to place three temporary barriers in south Delta channels. One of the barriers, at the head of Old River, is to determine if keeping Chinook salmon outmigrants in the San Joaquin River improves their chances of reaching the ocean. (See also, "1991 Salmon Study", page 4.) The other two barriers are to improve water levels and water quality for south Delta farmers. If approved, the barriers would be installed in April or May; the fish barrier would be in for a few weeks and the agricultural barriers for the summer.

DWR and USBR are working with DFG, NMFS, and USFWS to resolve fish and wildlife concerns associated with barrier installation. If these barriers are installed, Interagency Program staff will be conducting extensive fishery, plant, wildlife, and water quality monitoring to determine project impacts. If no significant environmental concerns are found in this 1-year study, the agencies will request 3 to 4 years of additional testing.

1991 Salmon Study

Pat Brandes and Marty Kjelson, USFWS

Studies since 1985 have shown fish released into the mainstem San Joaquin River have about a 50 percent better survival rate than those released in upper Old River. This has led fishery biologists to believe a barrier at the head of Old River may increase survival of San Joaquin smolts passing through the Delta. However, if exports remain at historical levels or greater, the barrier will change flow patterns, with more of the export water coming through channels other than Old River. The increased drafting will be in an area that has more tidal influence, and fish are believed to be better able to find their way to sea once they reach tidal waters. Therefore, this increased drafting may cause additional mortalities to both Sacramento and San Joaquin smolts downstream of the Old River barrier. Additional testing with the barrier in place is needed to evaluate mortality associated with increased cross-drafting.

In April and May 1991, several groups of coded wire tagged salmon smolts were released in the San Joaquin River to assess benefits of a barrier at Old River. In April, fish were released at five sites: Dos Reis Park, Stockton, Empire Tract, Jersey Point (all San Joaquin River), and Lighthouse Marina (lower Mokelumne River). In May fish where released at Stockton, Jersey Point, and Lighthouse Marina. Conditions were very different between the two months. In April, exports averaged about 6,000 cfs and temperatures averaged about 61 degrees at the release sites. In May, exports were near 3,000 cfs and temperatures were about 64 degrees.

Preliminary 1991 results and results of other years show that flow, temperature, exports, and diversion off the mainstem influence survival of smolts through the San Joaquin portion of the Delta.

In 1991, smolts showed increasingly better survival as they were released closer to the western Delta. Although it appeared a barrier would increase survival, additional mortality did occur at downstream diversion points (Turner Cut and Middle River).

We believe the Stockton release group most closely represents survival if the barrier were installed because the Stockton group is less vulnerable to reverse flows than the Dos Reis group. The Stockton survival index was about 50 percent higher (0.24 versus 0.16) than the Dos Reis Park index.

Temperatures for both months were lower than in many recent years and may account for the better survival in 1991. We already know temperature is important to survival of smolts in the Sacramento River, and additional data may show the same is true for the San Joaquin. We have tried to standardize our estimates to one temperature using the known relationship between temperature and survival in the Sacramento River.

After correcting for temperature, groups of smolts released at Stockton under low export conditions had a much higher survival rate (~0.21) than those released under high export conditions (~0.02), illustrating the benefits of reduced pumping.

In general, 1991 results support installation of a barrier at the head of Old River. However, studies to date cannot take the place of tests with a temporary barrier in place before any permanent barrier is installed.

Monitoring Vessels

Steve Hayes, DWR

DWR and USBR Interagency monitoring vessels are scheduled for extensive modifications in the near future to meet projected program needs and to ensure compliance with standards established in Water Right Decision 1485. Vessels to be modified are the 56-foot primary monitoring vessel, *San Carlos* (DWR), the 30-foot *Scrutiny* (USBR), and the 25-foot *Beowulf II* (DWR). The modifications will permit integrated monitoring where water quality and biological samples are collected concurrently at each site and at the same tidal stage. These modifications will accommodate the additional sampling requirements for each vessel, including vertical water column profiling and net tows for zooplankton and for fish eggs and larvae.

In general, physical modifications of the three vessels will be similar, consisting of reinforcing or modifying the aft decks to permit mounting of a dual davit system, a hydraulically powered winch on a deck stand, construction of a towing A-frame, and building a stern platform to protect the vessel and equipment during net and towing sled retrievals.

Modification of the *San Carlos* will be concurrent with a 15-year major overhaul or replacement of her main engines and generators. In addition, the electric fire pump system and davit system will be converted to a separate hydraulic system.

A unique modification of the *Scrutiny* will involve cutting the vessel in two just aft of the engine room bulkhead and extending her length aft 4 to 5 feet. Other modifications will include installation of a davit system, beefing up the engines to at least 200 horsepower, installing larger fuel tanks, and modifying the interior laboratory space and the aft deck to accommodate Interagency Program monitoring.

The davit and hydraulic system of *Beowulf II* underwent temporary modification early last spring so it could be used for striped bass surveys as well as water quality monitoring. It was used last year for striped bass and Delta smelt egg and larval sampling in the southern Delta. Permanent modifications, including a dual davit system, will be similar to those for *Scrutiny*.

After the physical modifications have been completed, water quality instrumentation on board the vessels will be upgraded and expanded. The upgrade will consist of improvements to the hull flow-through system and to the multiparameter instrumentation to provide a more complete vertical profile at each monitoring site. A dedicated on-board computer system will be added to support

DFG Sturgeon Program

Ray Schaffter and Dave Kohlhorst, DFG

White sturgeon inhabit large rivers and estuaries of the Pacific Coast from central California to southern Alaska. They are normally semianadromous, but there are reproducing freshwater populations that have been isolated by dams in the Columbia River drainage and, until recently, in Lake Shasta. White sturgeon are long-lived and late-maturing. Males spawn for the first time at about 10 to 12 years old, when they are 110 to 130 centimeters long. Females begin spawning at 12 to 16 years and at a length of 120 to 150 centimeters. In California, spawning occurs during late winter and spring in the Sacramento River between Knights Landing and Red Bluff, but in the past, spawning areas extended upstream of Shasta Dam. Some sturgeon may spawn in the San Joaquin River.

Sturgeon are the object of a popular sport fishery in the Sacramento/San Joaquin system and have also been the object of several DFG studies since 1954. The current program is designed to:

- Monitor adult white sturgeon abundance and mortality rates.
- Determine abundance and distribution of juvenile sturgeon in relation to biotic and abiotic factors such as egg production, streamflows, diversions, and salinity.
- Identify sturgeon spawning areas in the Sacramento River and define environmental characteristics of preferred spawning habitat.

All current sturgeon studies are supported by Federal Aid in Sport Fish Restoration Act and DFG funds.

The longest running survey, the adult tagging study, has captured sturgeon with large-mesh trammel nets in San Pablo Bay during 10 years between 1954 and 1991. This study has shown the population of sturgeon larger than 102 cm has fluctuated irregularly from about 11,000 in 1954 to 128,000 in 1984; present abundance is about 60,000. Natural mortality rate has been fairly constant, at about 6 to 10 percent, but exploitation rate increased from 1 percent in 1954 to more than 10 percent in the late 1980s. Population fluctuations have resulted from variable recruitment; the most recent strong year classes were from the early 1970s, 1982, and 1983. Abundance should increase when fish from the 1982 and 1983 year classes are recruited.

The high harvest rate in the late 1980s prompted DFG to recommend more restrictive angling regulations. Over a 4-year period, the minimum size limit is being increased from 102 to 122 cm and a new maximum length of 183 cm has been imposed. These changes are designed to increase egg production by reducing harvest prior to first spawning and completely protecting large, fecund females.

Because of the importance of sporadic large year classes in maintaining adult populations, future management of the sturgeon population requires early knowledge of year class abundance. The juvenile sturgeon study is designed to develop an index of year class strength that can be used to predict adult abundance and can also be related to environmental variables. This survey has sampled juvenile sturgeon from the western Delta to San Pablo Bay using small-mesh gill nets, otter trawls, and baited setlines. Sturgeon captured are measured and a section of the pectoral fin ray is removed for aging.

Juvenile sturgeon sampling is still in the experimental stage. Catches have been low in all gear types, although setlining holds promise of producing sample sizes adequate to calculate a reliable measure of year-class strength.

Earlier studies sampling sturgeon larvae with small-mesh tow-nets have identified the Sacramento River upstream of Knights Landing as the present spawning area for sturgeon. Within this reach, the river changes from a pool-riffle, medium gradient river to a low gradient, slow moving deep channel maintained by armored levees. The spawning habitat preference study is designed to determine which specific habitats within this long reach are critical for sturgeon spawning.

During 1990 and 1991, adult sturgeon were captured with setlines in the Sacramento River near Courtland and tagged with external radio transmitters. Fish movement during spawning migration were monitored by air and ground searches. During spring 1991, based on 1990 fish movements, we deployed artificial substrates designed to capture adhesive sturgeon eggs at eight locations between Grimes and Butte City. During these two low outflow years, sturgeon movement upstream appeared dependent on flow pulses. Fish tended to move upstream (as much as 20 km/day) during minor flow events. They ceased upstream movement or drifted slowly downstream when flow receded. Females left the system rapidly after spawning, moving downstream as much as 80 km in 21 hours. Most females spawned between Millers Landing (river km 177) and Colusa (river km 236). Only 10 eggs were collected on artificial substrates. These were aged based on developmental stage and were found to represent four spawning events. All eggs were taken within 10 km of Colusa.

In 1992, sturgeon studies will emphasize artificial substrate sampling for eggs and setline sampling for juveniles.

Staff Notes

- Ed Pearson has joined DFG's Delta Outflow/San Francisco Bay Study as a Marine Biologist. Ed earned his BS at San Francisco State University and is currently completing his MA at SFSU. He has previously worked in wetlands restoration, and as a staff technician at SFSU. He has also taught at SFSU and the University of San Francisco.
- Kenneth Miller recently joined DFG as a Marine Biologist on the Adult Striped bass and sturgeon project. He has a BS in Marine Biology from California State University, Long Beach. Kenneth has previously worked in several other DFG positions in Southern California.

CALL FOR PROPOSALS

Research Enhancement Program for
San Francisco Bay and the Sacramento-San Joaquin Delta

To encourage and expand research in the Bay and Delta, we intend to award grants in basic and applied research related to information needs of the sponsoring organizations. One type of grant will exclusively support graduate students or post-doctoral fellows. The second will not be restricted to student support.

AREAS OF RESEARCH INTEREST

Following are examples of areas of research interest. A more detailed list is included in the grant application packet.

FRESHWATER FLOW

- Assess effects of changes in magnitude and timing of freshwater flows on estuarine processes.
- Assess effects of flow changes on beneficial uses of the Bay and Delta.

ESTUARINE HYDRODYNAMIC PROCESSES
(Including Contaminant and Particulate Transport)

- Develop or refine mathematical models.
- Collect and analyze field data.

HABITAT

- Study effects of changes in habitat availability on biota of the Bay and Delta.
- Study effects of wetland loss on wetland and bay populations and communities.

POLLUTANTS

- Study processes and strategies for reducing pollutant inputs and impacts.
- Determine effects of contaminants on reproduction, growth, and survival of organisms using the aquatic and wetland environments of the Bay and Delta.

MANAGEMENT STRATEGIES

- Research social, economic, and regulatory processes that affect management of estuarine resources.

HUMAN HEALTH

- Assess effects on human health from uses of waterfowl, finfish, and shellfish from the Bay and Delta.

REVIEW OF GRANT PROPOSALS

Grant proposals will be reviewed by two committees:

- A peer review panel will review proposals for technical merit.
- An agency review panel representing the Estuary Project and the Interagency Program will select proposals for funding from those rated highly by peer reviewers.

Grants to scientists at research institutions will be made under a reimbursable agreement. Grants will not be made to private firms.

SELECTION CRITERIA

Proposals will be considered for funding based on the extent to which they are:

- Technically sound.
- Compatible with missions of the funding agencies.
- Problem-oriented or management-related.
- Ecosystem-oriented or process-oriented to assess human impacts.
- Relevant to environmental or land use policy formulation.

Although there will be a mix of funding for basic and applied research proposals, preference will be given to studies that lead to increased understanding of basic estuarine processes.

Grant recipients will be required to submit a "Quality Assurance Project Plan" in accordance with Environmental Protection Agency requirements included in the grant application packet.

PARTICIPATING PROGRAMS

The **Interagency Ecological Studies Program** consists of the:

- California Department of Water Resources
- California Department of Fish and Game
- State Water Resources Control Board
- U.S. Fish and Wildlife Service
- U.S. Geological Survey
- U.S. Bureau of Reclamation
- U.S. Army Corps of Engineers

The Interagency Program was initiated in 1971 to evaluate effects of the State Water Project and federal Central Valley Project on environmental resources of the Bay and Delta and to determine means of mitigating any adverse impacts. Evaluating water project impacts requires an understanding of how other factors influence estuarine biota so that project impacts can be sorted from the others. Through the Research Enhancement Program, we hope to stimulate the involvement of academic researchers in problems of the Bay and Delta and provide seed funding that can be used to attract money from other sources.

The **San Francisco Estuary Project**, started in 1987, is a component of the National Estuary Program of the Environmental Protection Agency. For designated estuaries of the National Estuary Program, the management process leads to implementation of a comprehensive conservation and management plan. One phase of the estuary project resulted in a series of reports on the status of and trends in such areas as estuarine resources, pollutants, and wetlands. Preparation of these reports has identified major gaps in our basic understanding of estuarine physical, chemical, and biological processes. This Research Enhancement Program is to help fill some of those gaps.

Those interested in applying for research grants may obtain a grant application packet from:

Perry L. Herrgesell, Ph.D., Study Manager
Interagency Ecological Studies Program
4001 North Wilson Way
Stockton, CA 95205
Phone: 209/466-4421

Proposals must be submitted no later than March 2, 1992.

Sonia Hamilton Killed During Oil Spill Investigation

Environmental specialist Sonia Hamilton was killed January 11 in a helicopter accident in Carquinez Strait. She was investigating an oil spill for DFG's Office of Oil Spill Prevention and Response.

Sonia received her BA from California State University, Stanislaus, and MA in marine sciences from CSU, Stanislaus, and Moss Landing Marine Laboratory. She started with DFG in 1980 as a seasonal aide, working for the Marine Recreational Fishery Intercept Program in the Monterey Bay area. Sonia began working in Stockton for the Delta Outflow/San Francisco Bay Study in May 1984 as a graduate student assistant and became the group's expert in larval crustacean identification. In 1987 Sonia was hired full-time as a fishery biologist and assumed responsibility for data analysis for a variety of species, including marine invertebrates, sharks and rays, white croaker, surf perches, anchovy, and herring. Her contributions have been an integral part of most reports and papers prepared in the past four years and will be part of several upcoming publications. In 1990, Sonia transferred to the Water Project Planning Unit of the Bay/Delta Division. Her work there included review and analysis of numerous issues involved with the Article 7 process and Delta water planning. In 1991, she moved to the Office of Oil Spill Prevention and Response in Vallejo.

Sonia was a close friend with a gentle spirit. She was a dedicated, professional biologist —a valued colleague. Her concern for the welfare of our natural resources and her strong motivation and commitment were an example for us all. Sonia was an avid photographer and needlepoint artist. She enjoyed sailing, skiing, and the company of her friends. She is survived by her husband, Alistair, and by her mother, sister, and brother.

A scholarship fund has been established at California State University, Stanislaus, to benefit marine biology students who attend classes at Moss Landing Marine Laboratory. If you would like to donate, please make your check payable to CSU, Stanislaus Foundation. Note on your check that it is a donation to the Sonia Linnik Hamilton Marine Sciences Scholarship Fund. Send your contribution directly to the CSU, Stanislaus Foundation, 801 West Monte Vista Avenue, Turlock, CA 95380.

Striped Bass Egg and Larval Transport Above the Delta Cross Channel

Chuck Hanson, Hanson Environmental, Inc.

Working under contract to the State Water Contractors, Chuck Hanson conducted a series of preliminary biological studies during May 1991 to evaluate effectiveness of a real-time striped bass egg and larval monitoring program for use in establishing timing of periodic closures of the Delta Cross Channel. Decisions regarding operation of the cross channel gates to reduce diversion of striped bass into interior Delta channels require information on:

- Temporal distribution of striped bass eggs and larvae passing an upstream monitoring location.
- Time required for planktonic eggs and larvae to be transported from the monitoring location to the Delta Cross Channel under various Sacramento River flow regines.
- Duration of exposure of planktonic eggs and larvae to diversion at the Delta Cross Channel under different spring flow conditions.

A series of preliminary studies were performed to determine transit time of striped bass eggs and larvae from a suitable upstream monitoring location (Bryte) to the Delta Cross Channel and temporal distribution of striped bass larvae near the cross channel entrance at Walnut Grove. Biological data were also collected at an intermediate location (Courtland) to provide preliminary quantitative data on the rate of striped bass egg and larval transport between Bryte and a potential water diversion site at Hood. In addition, a few samples were collected within the cross channel, in Georgiana Slough, and in the Sacramento River downstream of the cross channel, at Isleton.

A pulse of striped bass eggs was detected passing Bryte beginning at about 2100 hours on May 5 and continuing through May 6 (Figure 1), followed by a decline in egg densities during May 7 and 8. The peak density was 9 eggs per cubic meter on May 6. These results demonstrate the ability of the sampling program to detect passage of a pulse of striped bass eggs at Bryte, which can subsequently be tracked during transit downstream.

Estimated transit time of striped bass eggs and larvae between Bryte and Courtland, a distance of 28 miles, was about 2.5 days (60 hours) during this study; Sacramento River flow at "I" Street was about 6500 cfs. Transit time from Bryte to Walnut Grove (35 miles) was estimated at about 3.5 days (84 hours). As a result of variability inherent in striped bass densities, transit times should be considered an approximation. Downstream transit times that were estimated based on striped bass egg and larval sampling were substantially longer than independent estimates that were based on either calculated channel velocities or transit time for the drogues.

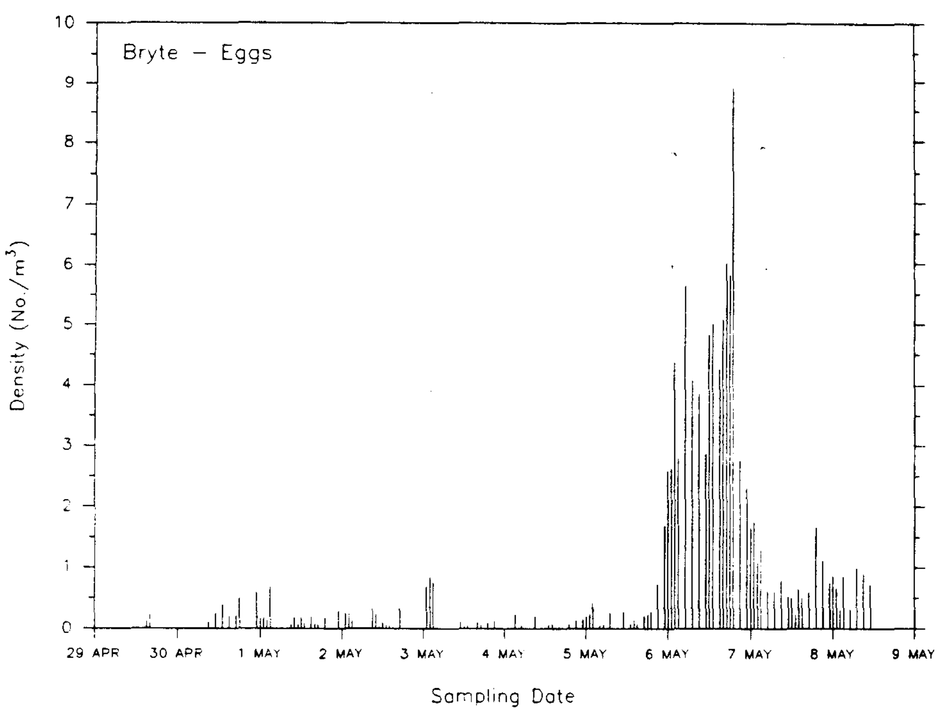

Figure 1
DENSITY OF STRIPED BASS EGGS AT BRYTE

Duration of exposure of striped bass larvae near Courtland was about 5 days (120 hours). A similar duration was estimated for larval transport near Walnut Grove. Duration of susceptibility of striped bass larvae to diversion at Walnut Grove or other locations in this reach of the Sacramento River is expected to be influenced by Sacramento River flow. Under higher flow conditions, the rate of downstream transport between Bryte and Walnut Grove is expected to be reduced, as would duration of susceptibility to diversion at the Delta Cross Channel.

An estimated 104 million striped bass eggs passed Bryte and 45 million striped bass larvae passed Walnut Grove during this study. The 57 percent reduction in abundance between Bryte and Walnut Grove is not unexpected given the relatively high mortality typically experienced by striped bass eggs and larvae. Results of these calculations do not support the hypothesis that unusually large reductions in abundance (80 to 90 percent) occur during periods of low Sacramento River flow, such as those that occurred during this investigation, as a result of eggs and larvae settling to the bottom of the river channel.

Results of this preliminary investigation of the rate of downstream transport of striped bass eggs and larvae in the Sacramento River have shown that:

- Sampling at Bryte is effective in detecting downstream transport of a pulse of striped bass eggs.
- Striped bass egg and larval sampling at Bryte would provide a real-time management tool for determining periods of closure for the Delta Cross Channel to coincide with peak striped bass egg and larval densities.
- At Sacramento River flows of about 6500 cfs, transit time for striped bass eggs and larvae has been estimated at about 2.5 days between Bryte and Courtland and about 3.5 days between Bryte and Walnut Grove.
- Transit time for a pulse of striped bass larvae passing Walnut Grove is estimated to be about 5 days under conditions existing during this investigation.

Use of Underwater Acoustics

Charles Liston, USBR, Denver

A multiagency cooperative program on use of underwater acoustics for influencing fish movement is being planned for late March. USBR and USCE (Waterway Experiment Station, Vicksburg, Mississippi, and Portland District) initiated activities early last year after early success in USCE acoustical experiments with blueback herring in the Savannah River. Other agencies expressing interest in a workshop and acoustical tests with several local species include DWR, DFG, USFWS, and Bonneville Power Authority.

A tentative program includes a 1-day workshop in Sacramento (scheduled for March 17) and on-site acoustical tests in Clifton Court Forebay with striped bass, Chinook salmon smolts, white catfish, and threadfin shad, if available. Other potential species include coho salmon smolts and squawfish.

Acoustical experts from other states will provide seminars and will coordinate field tests with the help of Interagency personnel.

If the field studies show acoustical sound waves can be used to divert fish, this could become a highly useful management tool in the Delta.

If you are interested in attending the workshop, please contact Jim Arthur, USBR, Sacramento, at 916/978-4923.

Noteworthy —

- The annual Interagency Workshop will be held at Asilomar Conference Center on February 19, 20, and 21. A tentative agenda is included in this newsletter. Attendance at the Asilomar conference is generally limited to Interagency staff, consultants, and invited speakers. A public workshop is scheduled for March 31 at ABAG's Metro Center in Oakland. When details are available, they will be sent to individuals on the *Newsletter* mailing list.
- The annual striped bass workshop will be held in Stockton on February 25 and 26. Local researchers working on striped bass will summarize their results, and members of EPRI's team from Oakridge National Laboratory and the East Coast working on an individual-based population model of the Bay/Delta striped bass population will describe their progress. Attendance is by invitation only. The spring *Newsletter* will summarize major points.
- The Research Enhancement Program, formerly called the Academic Research Involvement Program, released its call for proposals for 1992. It is reprinted on pages 6 and 7. This joint San Francisco Estuary Project/Interagency Program will have approximately $500,000 to allocate this year to universities and agencies submitting successful proposals to conduct Bay/Delta research.
- At the October briefing for the Interagency Directors a recommendation was made that the Environmental Protection Agency be invited to joint the Interagency Program. A letter extending this invitation was sent to the Regional Administrator in early January. Preliminary indications are that EPA will accept.
- The San Francisco Estuary Project's monitoring subcommittee is working on a comprehensive estuarine monitoring program. At a November meeting, the Aquatic Habitat Institute Board of Directors, at the request of SFEP, discussed the possible formation of an "AHI-like" entity that would provide the focus for estuarine research and monitoring. The Board will continue these discussions on January 17. The Interagency Coordinators are also discussing how our program might fit into a comprehensive monitoring program.
- In November 1991, SFEP released the first "working draft" of a Comprehensive Conservation and Management Plan. The first draft did not contain action plans for flow and wetlands; these are expected in February 1992. Over the next 10 months, staff and the various committees will be working to develop a final Comprehensive Conservation and Management Plan that can be signed by the Governor and EPA's Regional Administrator in December 1992.
- The Interagency Directors will meet on March 9 to approve budgets and programs for the coming fiscal year. USBR has asked that their transfers to DFG, USFWS, and DWR be on a calendar-year basis to better approximate scheduling of field work.

Publications

Two Interagency publications were recently released.

- The 1990 Annual Report
- DAYFLOW report for October 1, 1990, through September 30, 1991.

Copies of these reports can be obtained by calling Mary at (916) 323-7203.

In addition, USBR is distributing "Evaluation of Potential Striped Bass Egg and Larvae Management Scenarios by Use of a Numerical Salt Transport Model" and the "Executive Summary", describing results of its 1990 program. Four additional technical reports are being finalized and will soon be available as well. Contact Jim Arthur, USBR, 916/978-4923.

Salmon Monitoring

In December, Interagency program staff, under the direction of Marty Kjelson and Pat Brandes (USFWS), initiated a new Chinook salmon monitoring program near Sacramento. Although the study is designed primarily to answer questions regarding the use of the estuary by Chinook salmon fry, it will also provide information on migration of juveniles of all four races of Sacramento River Chinook salmon into the Delta. Sampling consists of midwater trawls, tow nets, and fyke nets. This sampling supplements the USFWS winter beach seine surveys, which will continue.

The new sampling program may find its first important use in detecting the arrival in the Delta of the 11,000 winter run juveniles reared at Coleman National Fish Hatchery and released in the Sacramento River near Redding.

Interagency Ecological Studies Program
NEWSLETTER
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STOCKTON CA 95205

Interagency Ecological Studies Program for the Sacramento-San Joaquin Estuary

NEWSLETTER

A Cooperative Effort of:

California Department of Water Resources
State Water Resources Control Board
U.S. Bureau of Reclamation
U.S. Army Corps of Engineers
California Department of Fish and Game
U.S. Fish and Wildlife Service
U.S. Geological Survey

Edited by:

Randy Brown, Department of Water Resources
Perry Herrgesell, Department of Fish and Game
Vera Tharp, Department of Water Resources

TENTATIVE AGENDA

IESP ANNUAL WORKSHOP
FEBRUARY 19-21, 1992
ASILOMAR CONFERENCE CENTER

February 19 (Wednesday)

1500	Arrive and Check In	
1800	Dinner (only served until 7:00 p.m.)	
1900	Social Hour and Guest Speaker (Possible presentation from Monterey Bay Aquarium Research Institute)	

February 20 (Thursday)

0815	Welcome and Announcements	Perry Herrgesell
0825	Striped Bass Model	Dave Kohlhorst
0850	Striped Bass Toxicology	Howard Bailey
0915	Delta Smelt-Life History and Sampling	Dale Sweetnam
0940	Winter-Run Salmon	Randy Brown
1005	BREAK	
1030	Research on Mixing Processes in Northern San Francisco Bay Using CTD Data	Ralph Cheng
1055	Collection of Flow Data for Calibration of the Delta Model	Rick Oltmann
1120	Recent Findings from the Delta Outflow San Francisco Bay Study	Randy Baxter
1145	Entrapment Zone - Is it or Isn't It?	Wim Kimmerer
1210	LUNCH	
1300	New Fish Facility Studies	Stein Buer
1315	CVP Tracy Fish Facility Studies	Charles Liston
1330	Clifton Court Forebay Predator Removal	Pat Coulston
1345	The Transport Model	Francis Chung